

Workshop on NPR 7120.6, "The NASA Lessons Learned Process"

Establishing an Effective NASA Center Process for Lessons Learned

David Oberhettinger

Office of the Chief Engineer
Jet Propulsion Laboratory
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Workshop Overview



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- Workshop Goal & Objectives
- Characteristics of the Existing NASA Lessons Learned System
- Overview of the Requirements of NPR 7120.6
- NPR 7120.5C Requirements Related to Lessons Learned
- Definition of the Existing Center Lessons Learned Process
- Alignment of the Center Lessons Learned Process with 7120.6
- Other Discussion Topics



Workshop Goal & Objectives



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Workshop Goal

- To achieve compliance with the newly released NPR 7120.6, and establish an effective lessons learned process at each NASA Center
 - An "Effective" Process: One that solicits, documents, and infuses lessons learned throughout the Center and NASA in a manner that will lead projects away from critical errors, or toward critical project success factors, encountered by their predecessors

Workshop Objectives

- Gain an understanding of the Center's existing lesson learned process
- Identify NASA and Center-specific issues related to the existing lessons learned process that may hinder or aid effective implementation of NPR 7120.6
- Identify Center and NASA process improvements needed for NPR compliance
- (Also identify effective lessons learned practices demonstrated at this Center that may be communicated to other Centers at subsequent workshops)



The Existing NASA LL System



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- NASA Centers have contributed 1500 lessons learned to the LLIS
- Lack of consistent Center lessons learned processes (and results)
- Objectives of issuing NPR 7120.6



Overview of NPR 7120.6



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- Overview of the NPR 7120.6 requirements pertinent to the Center lessons learned process.
 - Why do we need a NASA lessons learned process?
- NPR, Sec. 1.4, NASA Lessons Learned Organizational Requirements, includes the following paragraphs
 - NASA Headquarters, Office of the Chief Engineer (OCE)
 - Lessons Learned Steering Committee (LLSC)
 - Lessons Learned Committees (LLC)
 - Center Data Manager (CDM)
 - Headquarters Data Manager (HDM)
 - Lessons Learned Curator
- NPR, Appendix A, includes the following paragraphs
 - Collection and Processing
 - Infusion



NPR 7120.5C and the LL Process



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- Lessons learned content of NPR: 7120.5C, NASA Program and Project Management Processes and Requirements (March 22, 2005)
 - Ch 1, Overview of the NASA Environment; Para. 1.2, NASA's Strategic
 Framework. "NASA does the following: ... f. Continually learns and implements valuable lessons from previous programs and projects."
 - Ch 2, Program Mgmt. Reqs.; Para. 2.2, Program Formulation; 2.2.2.a, Prepare a Program Plan. "(3) The Program Manager shall evaluate lessons learned from existing and previously executed programs and projects to identify applicable lessons for use in program planning and execution."
 - Ch 3, Common Project Mgmt. Reqs.; Para. 3.2, Project Formulation; 3.2.1.2.a, Prepare the Project Plan. "(5) The Project Manager shall evaluate lessons learned from existing and previously executed projects to identify applicable lessons for use in project planning and execution."
 - Para. 3.4, Project Implementation; 3.4.8, Capture Knowledge. "3.4.8.1, Purpose: The intent of this activity is to accrue knowledge in an organized fashion to improve the performance, and reduce the cost and risk of future programs and projects, and to adhere to Federal and NASA requirements for records management and retention. Lessons learned are disseminated by the OCE and reflected in modifications to NASA training and technical standards and practices."



NPR 7120.5C (Continued)



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Lessons learned content of NPR: 7120.5C (Continued)

- Para. 3.4, Project Implementation; 3.4.8, Capture Knowledge. "3.4.8.2,
 Requirements: The Project Manager and the project team shall:
 "3.4.8.2.b: Provide the OCE with inputs to the Lessons Learned Information System in the form of captured experiences and lessons learned by the project team throughout the project lifecycle, for example, at major milestones."
- Ch 6, Flight Systems & Ground Support Projects; 6.2, Project Formulation.
 6.2.1, Project Planning Requirements: The Project Manager and the project team shall:
 - "6.2.1.g: Assure that the project team seeks to learn and apply relevant lessons from successful flight systems and ground support projects, mission anomalies and mishaps."



The Existing Center LL Process



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- Workshop participants assist in defining the present Center lessons learned process flow
- Characterize the existing Center process, e.g.
 - How is lesson acquisition planned?
 - How are lesson candidates validated?
 - How is lesson generation coordinated and managed?
 - How are lesson drafts edited, reviewed, and approved?
 - Is the lesson approval process sufficiently rigorous to prevent backlash?
 - How are products disseminated throughout the Center? How do you judge their impact?
 - How do lesson recommendations engage the Center's closed-loop corrective action process?
 - How are lesson recommendations infused into procedures and training.
- Discuss the strengths and deficiencies of the Center's process
 - Solicit possible improvements. Discuss solutions offered by other centers.



Session Break



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- 15-minute session break
- After the break, the remainder of the workshop will discuss process enhancements that may improve the Center's lessons learned process and bring it into closer alignment with the requirements of 7120.6.

Discussion will include methods that have proven successful at other centers

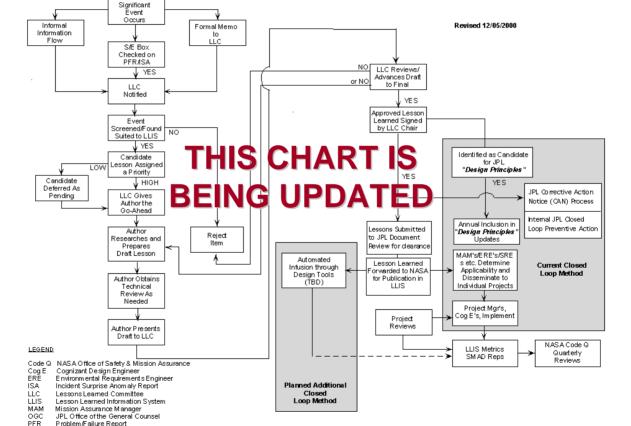


NASA Center Alignment with 7120.6



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 NPR 7120.6, Para. A1 refers to a range of activities constituting an effective lessons learned process, depicted in a process flowchart



Lesson Learned Process Flow Chart

Center process flow (JPL example)

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Safety & Mission Assurance Directorate

Subsystem Reliability Engineer Significant Event

SMAD

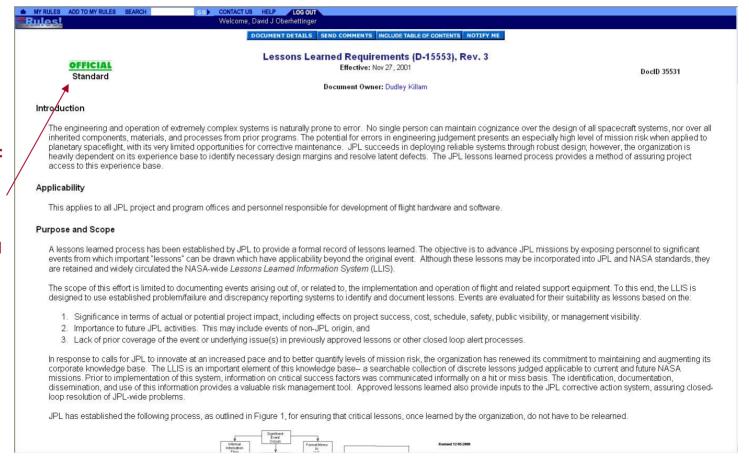
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 Para. A.1.1, Collection and Processing, refers to the central role of the Lessons Learned Committee (LLC) in the lessons learned process.



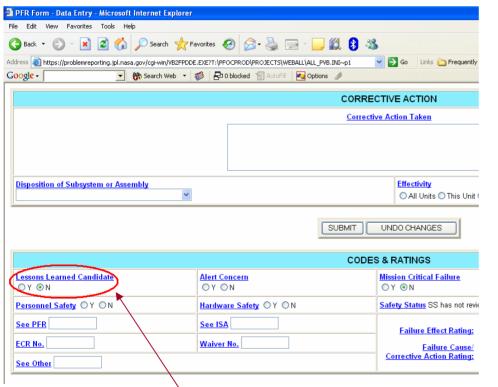
JPL example: process description published as a mandatory JPL standard





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- Para. A.1.1 further states, "The LLC procedures should include:
 - (a) Actively soliciting lessons learned material…"
 - Active vs. passive modes of LLC outreach



Checking the Lessons Learned Candidate box on the PRACA form (circled on the left) generates an automatic e-mail notification (on right).

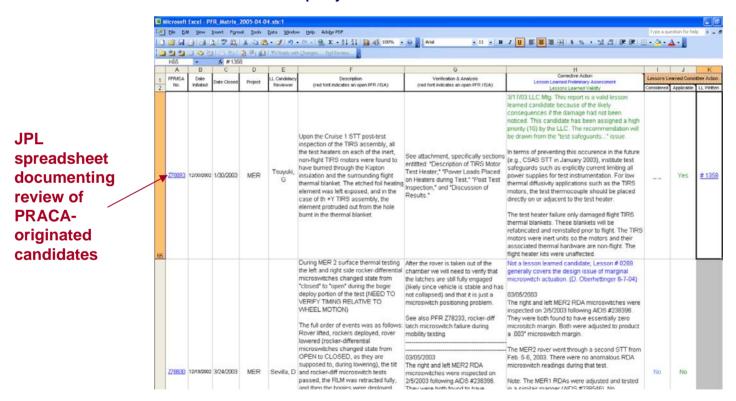
PFR-Pre Z78893 CLOSED: LESSONS LEARNED - Message (Plain Text) File Edit View Insert Format Tools Actions Help 🙉 Reply | 🙈 Reply to All | 🙈 Forward | 📑 🕒 | 🔻 | 🍅 | 💾 🗙 | 📤 🔻 🔻 🔘 PFO Center [Pfocenter@jpl.nasa.gov] Sent: Fri 1/31/2003 3:05 PM David.J.Oberhettinger@ipl.nasa.gov James.F.Clawson@jpl.nasa.gov; Carol.L.Dumain@jpl.nasa.gov; Dudley.B.Killam@jpl.nasa.gov Subject: PFR-Pre-Z70095 CLUSED: LESSONS LEARNED Document: Z78893 was Closed on 01/31/2003 and is designated for lessons Jearned consideration. Review via Unified Problem Reporting System (UPRs) Project: MER Title: TIRS Motor Test Heater Failures During Cruise 1 STT Tier 0: THRM - Thermal Tier 1: - TIRS Motor Test Heaters Written Bv: TSUYUKI, GLENN T Assigned To: Tsuvuki, Glenn T Description: (Max 10 lines) Upon the Cruise 1 STT post-test inspection of the TIRS assembly, all the test heaters on each of the inert, non-flight TIRS motors were found to have burned through the Kapton insulation and the surrounding flight thermal blanket. The etched foil heating element was left exposed, and in the case of the +Y TIRS assembly, the element protruded out from the hole burnt in the thermal blanket. Verification and Analysis: (Max 15 lines) See attachment, specifically sections entitlted: "Descript, of TIRS Motor Test Heater," "Power Loads Placed on Heaters during Test," "F - Test Inspection," and "Discussion of Results." Corrective Action: (Max 10 lines) In terms of preventing this occurence in the future (e.g., CSAS STT in January 2003), institute test safeguards such as explicitly current limiting all power cumplies for test instrumentation. For low thermal diffusivity amplications such as





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- (b) Reviewing significant events... for their candidacy as lessons learned
 - JPL reviews and prioritize candidate lessons based on their applicability to current and future projects



JPL LLC formally reviews PRACA reports designated as lessons learned candidates, and documents its findings.





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(c) Validating lessons learned with subject matter experts, if required

JPL LESSONS LEARNED COMMITTEE

Lesson Learned Candidate List

4/5/05

JPL LLC maintains a lesson candidate/
status list

Event *Rank Point of Contact Notes / Status

1.	If a Command References an Incorrect Transaction Request File (TRF) Name, the Command Will Be Ignored		Tim Larson	Tim Larson reports (4/5/05 D.K. e-mail[A1]) a lesson learned for other projects using CFDP for uplinks—ensure that all the ground tools and testbeds enable checking of these CFDP unique files. (Tim Larson to report at LLC meeting.)
2.	MER pixel corruption	D	PFR [Z77062][A2] LL Candidacy Reviewer: M. Schwochert	The LLC approved this as a candidate in its review PFR Matrix. D.O. Comment: a CAN assigned to Div 800 may be more appropriate than an LL, as this is a very detailed camera design issue. 4/4/05 LLC Mtg. deferred this topic to a PAN, with action item assigned to J. Krueger
3.	Deep Impact <u>High Resolution Instrument</u> focus (placeholder)	Р	PFR Z85620	This candidate is deferred until a failure investigation is completed
4.	Beagle 2 Commission of Inquiry: Recommendation 16	9	Lincoln Wood, Wyatt Johnson, Joe Guinn	http://www.spacedaily.com/news/beagle2-04g.html "A back-up for the entry detection event (T0) must be included in the design of planetary entry probes." Wyatt Johnson e-mail of 11/22/04: The MSL (Phase A) current chute deploy method is a g-trigger, with an IMU-navigated velocity trigger as a back-up. David O: This may represent a candidate for a positive LL. Aron Wolf concurs, but opines that this should not be linked to Beagle 2. 3/14 LLC mtg: This issue is closely related to the "negative" LL on the Genesis mission failure, and hence should await issuance of the Genesis MIB report.

^{*}Rank: 1-9 Priority (9 being the highest priority), P=Pending, D=Deferred Completed or invalidated candidates are moved to the Retired Candidate List.

JPL LLC tracks the status of lessons learned candidates from all sources and assigns a priority to each.





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- (d) Evaluating lessons learned submissions and developing a final lessons learned draft that includes actionable recommendations
- (e) Other procedural steps to ensure a quality product
- What methods has the Center found successful in obtaining timely draft lessons?
 - Who writes them: topic originator, single author/editor, a partnership?
 - Who reviews them, and how are conflicts resolved?
- What type of recommendations are appropriate and useful?
 - EXERCISE: Participants to review set of recommendations from a MIB report and discuss which would make good lessons learned-- and why. (Schedule for one hour into workshop?)





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Para. A.1.2, *Infusion Process*, states that "A lessons learned infusion process is required to 'close-the-loop' on actionable lessons learned recommendations at the Center and HQ levels."

Lesson Learned Disposition of LL Recommendation Title Lesson Learned Summary & Recommendations Related to Process **-**Completed. All DPS procedures must be required to conduct reviews of product design: see Five times during one month the "Unexecuted Command Counter" value was anomalous. Possible causes included incorrect incrementing of the counter, incrementing due to noise, or commands that were rejected due to incorrect bit patterns. The steps 3.8, 4.8, 5.8 and 6.3 in the Design Product Systems: Flight Subsystem/Instrument Design-Doc Counter Readings telemetry formats should be designed considering all potential analyses that may require time-tagged data. -M. Jahan (file: LL for DPS OPS Disposition-051304.xls), 5/18/04 307 Anomalous Five times during one month the "Unexecuted Command Counter" value was anomalous. Possible causes included incorrect Transferred. Add (also) to Software LL list AMPTE/CCD Command -M. Jahan (file: LL for DPS OPS Disposition-051304.xls), 5/18/04 incrementing of the counter, incrementing due to noise, or commands that were rejected due to incorrect bit patterns. The Counter Readings telemetry formats should be designed considering all potential analyses that may require time-tagged data. 308 Solder Balls in Flight Because a design change had been made to the proven Mariner design, the Viking orbiter flight radio modules developed short Completed, Covered by D-1348 Sect 3.11@2.8 & 3.2.1. Modules circuits caused by solder balls shorting terminal lugs to ground. Before making design changes, related applications -C. Kingery, 6/9/03 should be reviewed for known problems with this solder ball effect. Evaluate each design to determine whether solder can flow into uninspectable areas. 310 Mars Observer Inertial Mars Observer experienced inertial reference loss on several occasions during its cruise to Mars. These incidents were due to Completed, D-23713 (Para 3,3.4), Rev. 4 has been amended to state, "A detailed code walk-Reference Loss the lack of a detailed code walk-through, and to use of gyro noise values, obtained from in-house test, that were more optimistic through should be performed on post-launch changes (or patches) to critical flight software than the manufacturer's specifications. 2. Perform detailed code walk-through of critical software modules, and nodules." particularly of flight software patches. -per J. Hackney - 8/26/03 310 Mars Observer Inertial Mars Observer experienced inertial reference loss on several occasions during its cruise to Mars. These incidents were due to Completed, D-23713 (Para 4.2.4), Rev. 4 has been amended to state, "Reviews of inherited code Reference Loss the lack of a detailed code walk-through, and to use of gyro noise values, obtained from in-house test, that were more optimistic should address any known liens or defects as well as proper functionality." than the manufacturer's specifications, 3. Special attention should be paid to flight critical software performance that -per J. Hackney - 8/26/03 is inherited from previous applications. Prior anomalies must be addressed. 310 Mars Observer Inertial Mars Observer experienced inertial reference loss on several occasions during its cruise to Mars, These incidents were due to | Planned. New - Add to SDP (reinstate old SW Dev Prin.) Reference Loss the lack of a detailed code walk-through, and to use of gyro noise values, obtained from in-house test, that were more optimistic than the manufacturer's specifications. 4. Allow sufficient flexibility in the flight computer and software to permit 310 Mars Observer Inertial Mars Observer experienced inertial reference loss on several occasions during its cruise to Mars. These incidents were due to Planned. New addition will be made to Design Principle (SDP) Reference Loss the lack of a detailed code walk-through, and to use of gyro noise values, obtained from in-house test, that were more optimistic than the manufacturer's specifications, 1, Do not depend on hardware performance being better than the 311 STS-56 High Rate Data The high rate data channel for ATMOS failed. No complete end-to-end test had been performed either prior to or after the flight. Completed. Fully infused by Doc ID 31432 (Assembly Test and Launch Operations (ATLO), Rev. Channel Failure Impact 1. End-to-end tests must be performed. 3), 3.2.1(6), Doc ID 31335 (System Test and Launch Operations (STLO) Guide Executive to ATMOS Experiment Summary, Rev. 2), IV.C.d & IV.C.f, Doc ID 35506 (Anomaly Resolution (D-8091), Rev. 3), 3.3.7, Doc ID 46792 (System Test and Launch Operations (STLO), Rev. 0), 4.3.4.2. -S. Barry Spreadsheet (ITMS_Lessons learned.xls), 5/28/04 311 STS-56 High Rate Data 2 The high rate data channel for ATMOS failed. No complete end-to-end test had been performed either prior to or after the flight. Completed. Fully infused by Doc ID 31432 (Assembly Test and Launch Operations (ATLO), Rev. Channel Failure Impact 2. Ensure that end-to-end tests to determine failure modes are performed prior to the disassembly of the 3), 3,2,1(6), Doc ID 31335 (System Test and Launch Operations (STLO) Guide Executive to ATMOS Experiment Summary, Rev. 2), IV.C.d & IV.C.f, Doc ID 35506 (Anomaly Resolution (D-8091), Rev. 3), 3.3.7, Doc ID 46792 (System Test and Launch Operations (STLO), Rev. 0), 4.3.4.2. -S. Barry Spreadsheet (ITMS_Lessons learned.xls), 5/28/04

Track the status of lessons learned infusion into Center-wide processes (procedures and training).

Rev. 4/12/05

processes) JPL tracks the status of each recommendation assigned to multiple JPL which may be



Other Discussion Topics



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- Attendee Feedback. Suggestions for improving subsequent NASA center workshops are solicited.
- Lessons Learned Technology Enhancements. How do we get more clever about telling our stories?
- Evaluating Success. Are the present measures of NASA lessons learned process success adequate? Are there better metrics for evaluating our performance? How is lessons learned performance evaluated by other enterprises?